

April 2007 Cold Wave

National Oceanic and Atmospheric Administration

National Climatic Data Center

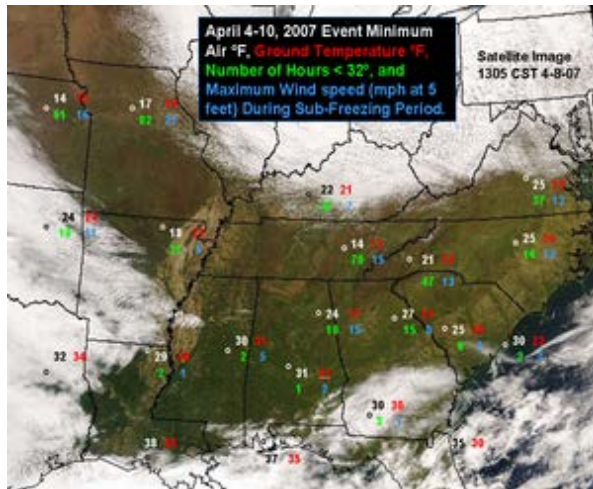


Note: Data in this report are compiled from preliminary statistics
Updated 9 May 2007

Overview

The April 2007 Cold Wave occurred across much of the central Plains, Midwest and into the Southeast during the 4th through the 10th. For the month as a whole, April temperatures across the contiguous U.S. were [near average](#) ranking 47th coolest, although [below average temperatures](#) are apparent in these [affected regions](#). The impacts of this cold air outbreak are extensive and still have yet to be completely quantified. Perhaps the most significant impact of this cold wave is related to the timing and duration of the event in concert with crop emergence and tree blooms. Winter wheat across the central Plains and Midwest and emerged corn and blooming fruits across the southern U.S. were perhaps among the hardest hit agricultural crops.

Several factors made this cold wave more harmful to agricultural interests than similar events in the past. March 2007 was [exceptionally warm](#) across a large portion of the U.S. from the northern Plains through the Mississippi Valley and into the Southeast. A [dominant ridge](#) of high pressure, entrenched across the contiguous U.S., allowed average monthly temperatures to exceed average conditions by more than 6°F across this region. The prolonged warm spell led to a premature leaf and bloom for many plants and trees across the region. In contrast to the warmth across the Lower 48 states, cold air was entrenched across much of [Alaska](#) making it the [3rd coldest](#) March on record for the state.



In early April, a pattern shift brought this cold Arctic air southward into the central and eastern U.S. This record-breaking cold air penetrated much of this region from April 4-10 bringing near-record to record cold temperatures to parts of the central Plains and much of the Southeast. Temperatures in some locations dropped into the teens and lower 20s overnight with many hours of [sub-freezing temperatures](#) on multiple and subsequent days. As many as four to five nights of extremely cold temperatures coupled with sustained desiccating winds during the sub-freezing period made this event more harmful for plants and trees and brought extensive losses to

agricultural interests.

In [northern Alabama](#), minimum temperatures during this event generally fell into the lower to mid 20s with between 9 and 46 hours of temperatures below 32°F from April 7-10. [Visible evidence](#) from satellite shows the browning of vegetation which took place between the 5th and the 8th across the Cumberland Plateau of Tennessee and northern Alabama.

CRN

Data from the [Climate Reference Network \(CRN\)](#) across the central Plains and Southeast are shown in the figure below. During the time of the killing freeze, April 4-10, several CRN stations reported minimum temperatures in the teens. These include Batesville, AR (18°F), Manhattan, KS (14°F), Chillicothe, MO (17°F) and Crossville, TN (14°F). The number of hours the minimum air temperature was below 32°F across much of the region was considerable.

Temperature & Wind Data - Killing Freeze, April 4-10, 2007

(Data From USCRN Network)

STATION WIND (mph)	MINIMUM	MINIMUM	NO. OF HOURS MIN AIR TEMP					MAX 10-SEC	AVG
	AIR TEMP °F	IR TEMP °F	≤ 32°	≤ 28°	≤ 24°	≤ 20°	≤ 16°	WIND (mph)	SPEED
Gadsden, AL	24	17	19	11	0	0	0	15	5
Selma, AL	31	31	1	0	0	0	0	2	0
Batesville, AR	18	21	21	17	7	2	0	4	2
Watkinsville, GA	27	22	15	2	0	0	0	8	3
Newton 8, GA	30	30	3	0	0	0	0	1	0
Manhattan, KS	14	15	61	28	16	9	2	16	7
Bowling Green, KY	22	21	47	23	9	0	0	7	1
Monroe, LA	29	38	2	0	0	0	0	1	0
Chillicothe, MO	17	16	82	54	21	5	0	22	9
Newton, MS	30	31	2	0	0	0	0	5	4
Asheville, NC	21	14	47	27	9	0	0	13	3
Durham, NC	25	24	16	3	0	0	0	13	4
Stillwater, OK	24	24	19	8	0	0	0	11	4
Blackville, SC	25	26	9	3	0	0	0	2	<1
McClellanville, SC	30	22	2	0	0	0	0	3	0
Crossville, TN	14	13	70	45	16	7	3	15	4
Charlottesville, VA	25	23	37	11	0	0	0	13	3

NOTE: All wind data is for only the hours during which the temperatures were < 32° F and were measured at 5 feet above ground level.

Additional Information

When looking at the 20th Century mean for the contiguous U.S., April is warmer than March on average by about 9°F. Comparing March and April temperatures across the central, southern and southeastern portions of the U.S., we see that in many cases, March and April were very similar. Seven of the sixty [U.S. Climate at a Glance cities](#) were actually colder in April when compared with March. They include: Amarillo, TX, Birmingham, AL, Dallas, TX, Jackson, MS, Tulsa, OK, Wichita, KA, and Kansas City, MO. Ten additional cities had April average temperatures warmer than March, yet within 1°F of each other.

Statewide temperature averages indicate that April was colder than March across Arkansas, Kansas, Mississippi, Oklahoma, Tennessee and Texas. A comparison of March and April statistics is listed in the table below.

State	March 07 Avg Temp	April 07 Avg Temp	March Dep (from 20th Century Avg)	April Dep (from 20th Century Avg)
Arkansas	59.3°F	57.6°F	+7.7°F	-3.0°F
Kansas	52.1°F	51.4°F	+9.5°F	-2.0°F
Mississippi	61.3°F	60.9°F	+5.5°F	-2.8°F
Oklahoma	57.9°F	55.7°F	+8.8°F	-3.4°F

Tennessee	56.5°F	55.8°F	+7.8°F	-1.9°F
Texas	61.7°F	61.5°F	+4.5°F	-3.6°F

Records

Between the 4th and 10th there were 1237 broken (321 tied) daily minimum temperature records in the Contiguous United States. (These records are based on the historical daily observations archived in NCDC's TD-3200 data set and preliminary reports from Cooperative Observers and First Order National Weather Service stations, and as such are subject to change.)

[Selected U.S. City and State Extremes for April.](#)

Daily Minimum Temperature Records

- [April 4, 2007](#)
- [April 5, 2007](#)
- [April 6, 2007](#)
- [April 7, 2007](#)
- [April 8, 2007](#)
- [April 9, 2007](#)
- [April 10, 2007](#)

Southeast

April 6-9, 2007 Records Summary in the Southeast

Record Monthly Lows				
Date	City	New/Tie Record	Old Record	Old Date
April 7, 2007	Asheville Regional Airport, NC	20	22	April 1, 1987
April 8, 2007	Savannah Airport, GA	28	32	April 8, 1962
April 8, 2007	Augusta Regional Bush Field. GA	26	26	April 7, 1982
April 8, 2007	Alma, GA	30	31	April 8, 1987
April 8, 2007	Columbia Metro. Airport, SC	26	26	April 20, 1983
April 8, 2007	Greenville-Spartanburg Airport, SC	24	25	April 20, 1983
April 8, 2007	Charlotte Douglas Intl. Airport, NC	21	24	April 1, 1923

April 8, 2007	Jacksonville, FL	31	34	April 8, 1987
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Record Daily Lows

Date	City	New/Tie Record	Old Record	Old Year
April 6, 2007	Danville, VA	28	28	2004
April 6, 2007	Salisbury, MD	23	26	2002
April 7, 2007	Greenville-Spartanburg Airport, SC	28	28	1950
April 7, 2007	Columbia Metro. Airport, SC	30	30	1982
April 7, 2007	Asheville Regional Airport, NC	20	25	1982
April 7, 2007	Charlotte Douglas Intl. Airport, NC	25	27	1950
April 7, 2007	Wilmington, NC	32	34	1950
April 7, 2007	Northwest AL Regional Airport Muscle Shoals, AL	26	30	1982
April 7, 2007	Huntsville Intl. Airport, AL	25	27	1950
April 7, 2007	Atlanta, GA	28	29	1982
April 8, 2007	Salisbury, MD	25	27	1990
April 8, 2007	Washington National	29	29	1982
April 8, 2007	Danville, VA	22	26	1961
April 8, 2007	Lynchburg, VA	22	24	1970
April 8, 2007	Bluefield, VA	21	22	1972
April 8, 2007	Elizabeth City, VA	27	29	1982
April 8, 2007	Norfolk, VA	33	33	1972
April 8, 2007	Charleston Airport, SC	30	34	1950
April 8,	Downtown Charleston, SC	38	43	1972

2007				
April 8, 2007	Columbia Metro. Airport, SC	26	31	1971
April 8, 2007	Greenville-Spartanburg Airport, SC	24	32	1990
April 8, 2007	Florence, SC	26	34	1971
April 8, 2007	N. Myrtle Beach, SC	29	30	1950
April 8, 2007	Asheville Regional Airport, NC	22	26	1994
April 8, 2007	Raleigh-Durham Intl. Airport, NC	27	28	1975
April 8, 2007	Piedmont Triad Intl. Airport, NC	25	28	1990
April 8, 2007	Charlotte Douglas Intl. Airport, NC	21	30	1961
April 8, 2007	Wilmington, NC	29	33	1972
April 8, 2007	New Bern , NC	30	31	1950
April 8, 2007	Northwest AL Regional Airport Muscle Shoals, AL	26	30	1939
April 8, 2007	Huntsville Intl. Airport, AL	26	28	1958
April 8, 2007	Mobile Regional Airport, AL	38	39	1990
April 8, 2007	Pinson, AL	25	27	1990
April 8, 2007	Jacksonville, FL	31	37	1971
April 8, 2007	Pensacola Regional Airport, FL	39	41	1939
April 8, 2007	Gainesville, FL	35	38	1950
April 8, 2007	Brunswick, GA	37	38	1950
April 8, 2007	Alma, GA	30	34	1950
April 8, 2007	Athens, GA	27	32	1990
April 8,	Atlanta, GA	30	32	1886

2007				
April 8, 2007	Macon, GA	28	30	1990
April 8, 2007	Augusta Regional Bush Field. GA	26	32	1971
April 8, 2007	Savannah Airport, GA	28	35	1950
April 9, 2007	Savannah Airport, GA	31	36	2000

Record Daily Lowest Maximums

Date	City	New/Tie Record	Old Record	Old Year
April 7, 2007	Roanoke, VA	39	45	1982
April 7, 2007	Bluefield, VA	27	36	1982
April 7, 2007	Savannah Airport, GA	56	62	1950
April 7, 2007	Downtown Charleston, SC	56	57	1982
April 7, 2007	Columbia Metro. Airport, SC	51	53	1907
April 7, 2007	Asheville Regional Airport, NC	38	48	1973
April 7, 2007	Huntsville Intl. Airport, AL	45	50	1939
April 7, 2007	Northwest AL Regional Airport Muscle Shoals, AL	46	48	1958
April 7, 2007	Tallahassee, FL	58	59	1898
April 8, 2007	Tallahassee, FL	58	61	1899
April 8, 2007	Savannah Airport, GA	59	61	1982

Record Daily Snow

Date	City	New/Tie Record	Old Record	Old Year
April 7, 2007	Baltimore, MD	0.2	0.2	1972
April 7, 2007	Greenville-Spartanburg Airport, SC	T	0	-

April 7, 2007	Raleigh-Durham Intl. Airport, NC	T	0	-
April 7, 2007	Asheville Regional Airport, NC	1.2	1	1989
April 7, 2007	Elizabeth City, VA	T	0	-
April 7, 2007	Richmond, VA	1	0.2	1990
April 7, 2007	Salisbury, MD	1.2	1	1990

Provided by William Schmitz, Southeast Regional Climate Center

Deep South

- [Little Rock, AR](#)

Plains

- [Lubbock, TX](#)
- [San Angelo, TX](#)
- [Amarillo, TX](#)

Crop Damage

The April 2007 Cold Wave brought significant crop losses across the central Plains, Midwest, and into the Southeast. Although the extent of damage has not been fully assessed, losses may total billions of dollars in the affected states.

The event brought extensive losses mainly due to the anomalous warmth during the month of March which helped induce an earlier spring blossom, in some cases two weeks prior to crop development in 2006. Over the weekend of 6-9 April, average low temperatures across the south were on average 24°, 20°, 16°, and 18°F, each of those days respectively; all temperatures below the critical threshold of 28°F. If mean temperatures are below that critical temperature developing fruit and blossoms are likely to suffer damage. At 25°F, agricultural officials said, farmers can expect to lose about 90 percent of their crop.

According to Virginia's Department of Agriculture and Consumer Services peaches and apples were the most affected in Virginia, with apple losses varying from 5% to 90% and peach losses varying from 80% to 100%, depending on the area. Meanwhile, [North Carolina's Department of Agriculture and Consumer Services](#) reported a preliminary estimate of at least \$112 million in crop losses.

The following table provides a summary of Very Poor to Poor crop conditions for the period prior to and after the cold wave. The information found below was provided by [U.S. Department of Agriculture / National Agricultural Statistics Service](#).

Affected States	Pre-Freeze	Post-Freeze
Alabama		
Winter Wheat	14% (04/01)*	36% (04/22)
Arkansas		
Winter Wheat	6% (04/01)	64% (04/23)
Corn	16% (04/08)	58% (04/22)
Pastures	15% (04/01)	25% (04/22)
Georgia		
Corn	3% (04/01)	26% (04/22)
Pastures	34% (04/01)*	49% (04/22)
Apples	0% (04/01)	99% (04/22)
Peaches	5% (04/01)	83% (04/22)
Tobacco	0% (04/01)	30% (04/22)
Illinois		
Winter Wheat	9% (04/01)	29% (04/23)
Alfalfa	NR	32% (04/22)
Red Clover	NR	32% (04/22)
Indiana		
Winter Wheat	12% (04/01)	30% (04/22)
Kansas		
Winter Wheat	4% (04/01)	41% (04/22)
Kentucky		
Corn	NR	39% (04/22)
Strawberries	NR	66% (04/22)
Missouri		
Winter Wheat	8% (04/01)	64% (04/23)
Pastures	17% (04/01)	39% (04/22)
North Carolina		
Winter Wheat	3% (04/01)	39% (04/23)
Peaches	NR	98% (04/22)
Truck Crops	2% (04/01)	35% (04/22)
Irish Potatoes	6% (04/01)	30% (04/22)
Rye	1% (04/01)	58% (04/22)
Barley	1% (04/01)	55% (04/22)
Oats	0% (04/01)	31% (04/22)

Ohio

Winter Wheat	26% (04/01)**	27% (04/22)
Apples	8% (04/08)	60% (04/22)
Peaches	12% (04/08)	70% (04/22)

South Carolina

Winter Wheat	1% (04/01)	50% (04/22)
Corn	1% (04/01)	46% (04/22)
Pastures	11% (04/01)	25% (04/22)
Apples	NR	90% (04/22)
Peaches	NR	87% (04/22)
Tobacco	NR	48% (04/22)
Cucumbers	0% (04/01)	70% (04/22)
Snapbeans	0% (04/01)	70% (04/22)
Cantalopes	0% (04/01)	45% (04/22)
Watermelons	0% (04/01)	43% (04/22)
Oats	1% (04/01)	41% (04/22)

Tennessee

Winter Wheat	3% (04/01)	84% (04/22)
Apples	0% (04/08)	91% (04/22)
Peaches	NR	98% (04/22)
Strawberries	NR	39% (04/22)
Pastures	31% (04/01)*	32% (04/22)

Virginia

Peaches	2% (04/01)	86% (04/22)
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NR = Not Reported

* Due to drought

** Due to wetness

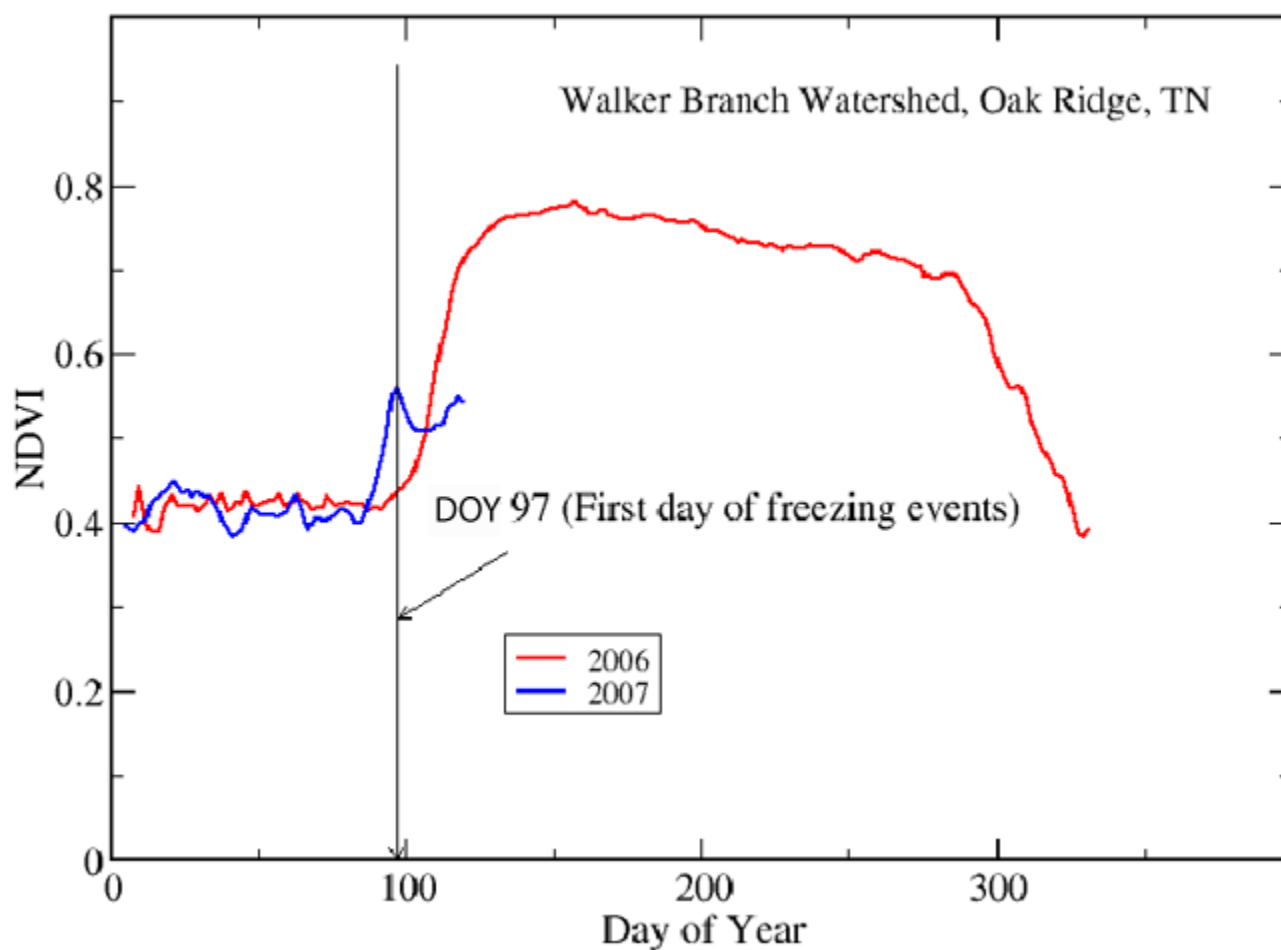
Information provided by [U.S. Department of Agriculture / National Agricultural Statistics Service](#)

Other Impacts

In addition to the extensive crop losses discussed above, there are indications that losses in vegetative cover resulted in other impacts beyond the immediate damages. Scientists in NOAA's Air Resources Laboratory, [Atmospheric Turbulence and Diffusion Division](#), have observed a decline of carbon dioxide uptake by the forest ecosystems as well as an impact on the energy budget of the region. Content for this section was provided by Dr. Tilden Meyers at ATDD.

Vegetation Health

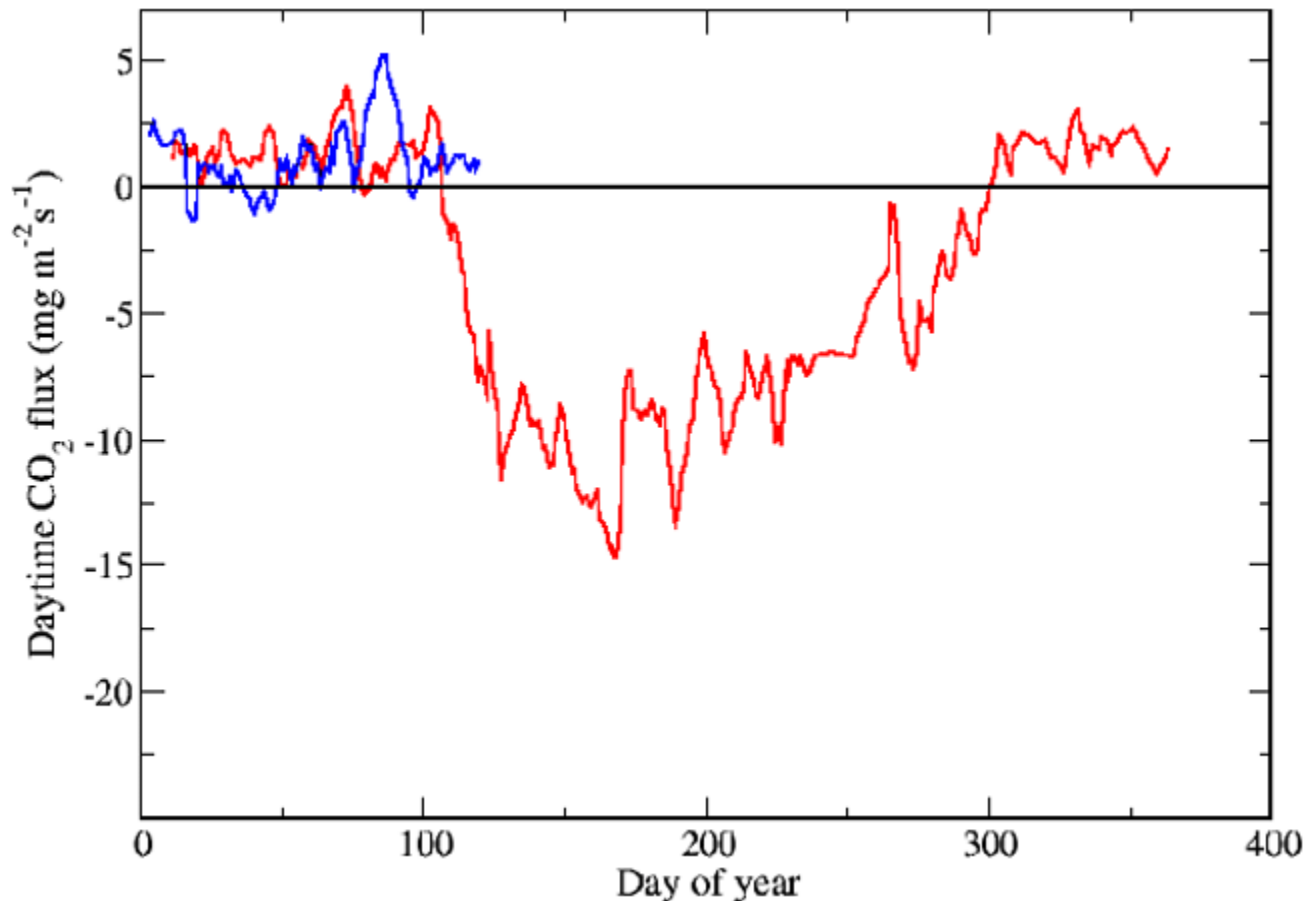
The early green up resulting from the unusually warm temperatures in March is clearly depicted from in-situ observations from two of NOAA's Surface Energy Balance Network (SEBN) towers located on the Walker Branch Watershed and Chestnut Ridge towers in Oak Ridge, Tennessee. As shown in the figure below, the Normalized Difference Vegetation Index (NDVI), an indicator of plant canopy green leaf area, clearly shows the early green-up relative to last year with the sharp rise occurring about 3 weeks earlier than in 2006. The dramatic impact of the widespread and intense spring freeze is clear from the sharp drop in the NDVI value on day 98 (April 8). The NDVI is only 25% above the winter baseline at a time when it should be at a maximum. The recovery of the vegetation is beginning, but the pace and extent to which the vegetation recovers will become evident in the coming weeks.



Carbon Dioxide Uptake

The increase in carbon dioxide (CO₂) uptake by tree and plant life that normally occurs as forests leaf out in the spring has also been impacted by the record cold. The graph below depicts the consequent decline of CO₂ uptake by the forest ecosystems (blue line - 2007; red line - 2006, typical pattern of increasing carbon dioxide uptake in the spring season). As of May 3, for the daytime period, the average integrated CO₂ flux did not yet show a sink (negative fluxes; uptake

of CO₂ from the atmosphere), when under normal conditions it would be showing a maximum daily uptake. (While human and animal life breath in oxygen and exhale carbon dioxide, healthy forests take in carbon dioxide and release oxygen.) Negative CO₂ fluxes (net uptake of carbon dioxide) would be evidence of a healthy forest ecosystem.



Surface Radiation Budget (Heat and Evaporation)

The lack of normal amounts of vegetative cover is resulting in more of the sun's energy being used for heating the atmosphere instead of evaporating water from trees and plant life. The evapotranspiration from the canopy (transfer of moisture from vegetation and the Earth's surface to the atmosphere) is ¼ of what is normally expected for early May. Conversely, sensible heat flux is much higher, which results in more of the sun's energy being used to heat the air near the Earth's surface. These conditions are somewhat analogous to conditions in the desert, where radiation from the sun acts to raise the temperature of the air instead of evaporating moisture from vegetation and the ground.

The resulting warmer air temperatures and reduced moisture in the atmosphere have the potential to exacerbate drought conditions in the region. In early May, severe to extreme drought covered an area that stretched from western North Carolina, southern Tennessee and northern Georgia to eastern Mississippi. Severe to extreme drought was also present in southern Georgia, where the largest wildfire on record for the state continued to burn in early May. Drought also affected

parts of Florida, the Southwest US, and areas of the northern Rockies, northern High Plains, and northern Minnesota. Additional drought information is available in the [April US Drought report](#).

Citing the Article

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